



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 9, 2023 – 10:49 PM EDT

PDB ID : 7LPG
Title : APE1 product complex with abasic ribonucleotide DNA
Authors : Freudenthal, B.D.; Hoitsma, N.M.
Deposited on : 2021-02-11
Resolution : 2.08 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.35.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35.1

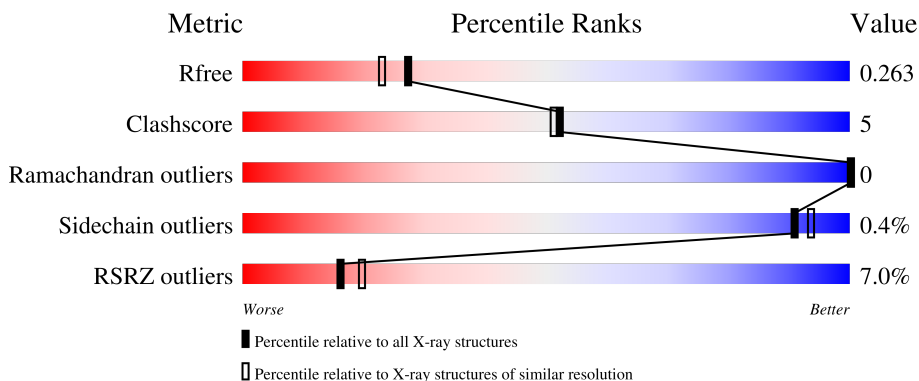
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.08 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	6189 (2.10-2.06)
Clashscore	141614	6738 (2.10-2.06)
Ramachandran outliers	138981	6663 (2.10-2.06)
Sidechain outliers	138945	6664 (2.10-2.06)
RSRZ outliers	127900	6057 (2.10-2.06)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	B	276	<div style="display: flex; align-items: center;"> <div style="width: 8%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 88%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 12%; height: 10px; background-color: yellow;"></div> </div>
1	D	276	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 88%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 10%; height: 10px; background-color: yellow;"></div> <div style="width: 5%; height: 10px; background-color: grey;"></div> </div>
2	C	21	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 62%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 38%; height: 10px; background-color: yellow;"></div> </div>
3	E	10	<div style="display: flex; align-items: center;"> <div style="width: 70%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 30%; height: 10px; background-color: yellow;"></div> </div>
4	A	11	<div style="display: flex; align-items: center;"> <div style="width: 18%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 82%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 18%; height: 10px; background-color: yellow;"></div> </div>

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 5411 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called DNA-(apurinic or apyrimidinic site) lyase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	B	275	2167	1384	377	398	8	0	0	0
1	D	272	2157	1380	373	395	9	0	1	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	138	ALA	CYS	engineered mutation	UNP P27695
D	138	ALA	CYS	engineered mutation	UNP P27695

- Molecule 2 is a DNA chain called DNA (5'-D(*GP*GP*AP*TP*CP*CP*GP*TP*CP*GP*AP*GP*CP*GP*CP*AP*TP*CP*AP*GP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	C	21	428	203	82	123	20	0	0	0

- Molecule 3 is a DNA chain called DNA (5'-D(*GP*CP*TP*GP*AP*TP*GP*CP*GP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	E	10	203	97	38	59	9	0	0	0

- Molecule 4 is a DNA chain called DNA (5'-R(P*N)-D(P*CP*GP*AP*CP*GP*GP*AP*TP*CP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
4	A	11	217	101	39	66	11	0	0	0

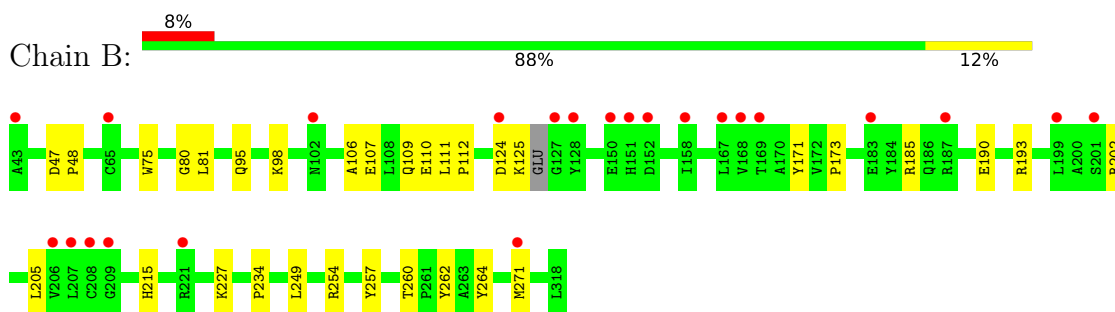
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	73	Total O 73 73	0	0
5	C	21	Total O 21 21	0	0
5	D	135	Total O 135 135	0	0
5	E	6	Total O 6 6	0	0
5	A	4	Total O 4 4	0	0

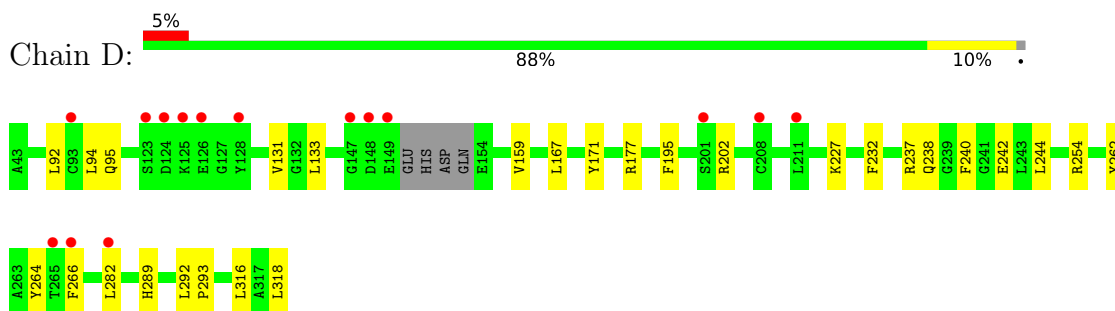
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

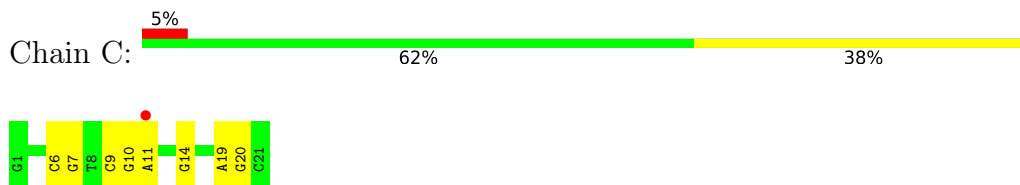
- Molecule 1: DNA-(apurinic or apyrimidinic site) lyase



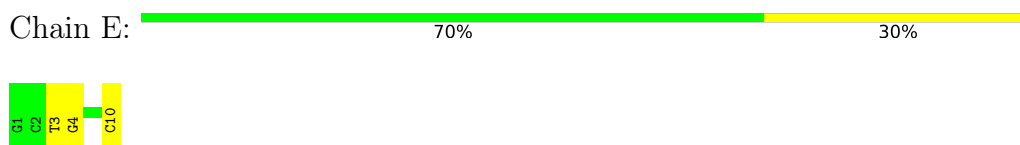
- Molecule 1: DNA-(apurinic or apyrimidinic site) lyase



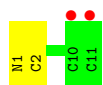
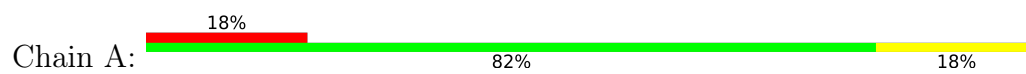
- Molecule 2: DNA (5'-D(*GP*GP*AP*TP*CP*CP*GP*TP*CP*GP*AP*GP*CP*GP*CP*AP*TP*CP*AP*GP*C)-3')



- Molecule 3: DNA (5'-D(*GP*CP*TP*GP*AP*TP*GP*CP*GP*C)-3')



- Molecule 4: DNA (5'-R(P*N)-D(P*CP*GP*AP*CP*GP*GP*AP*TP*CP*C)-3')



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	44.12Å 61.08Å 73.04Å 83.68° 78.07° 87.49°	Depositor
Resolution (Å)	23.69 – 2.08 23.69 – 2.08	Depositor EDS
% Data completeness (in resolution range)	84.4 (23.69-2.08) 72.0 (23.69-2.08)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.71 (at 2.08Å)	Xtrriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.219 , 0.263 0.219 , 0.263	Depositor DCC
R_{free} test set	1724 reflections (4.54%)	wwPDB-VP
Wilson B-factor (Å ²)	34.7	Xtrriage
Anisotropy	0.399	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 40.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5411	wwPDB-VP
Average B, all atoms (Å ²)	46.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.45% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	B	0.44	0/2223	0.61	0/3014
1	D	0.48	0/2212	0.62	0/2998
2	C	0.75	0/480	0.92	0/739
3	E	0.80	0/227	1.05	0/349
4	A	0.73	0/228	0.80	0/349
All	All	0.52	0/5370	0.69	0/7449

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	2167	0	2132	22	0
1	D	2157	0	2135	23	0
2	C	428	0	236	5	0
3	E	203	0	114	2	0
4	A	217	0	119	5	0
5	A	4	0	0	0	0
5	B	73	0	0	2	0
5	C	21	0	0	1	0
5	D	135	0	0	3	0
5	E	6	0	0	0	0
All	All	5411	0	4736	53	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 5.

All (53) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:D:450:HOH:O	4:A:1:N:H1'2	1.92	0.69
1:D:316:LEU:HB3	1:D:318:LEU:HD13	1.82	0.61
1:B:124:ASP:O	1:B:125:LYS:C	2.39	0.61
1:B:124:ASP:CG	1:B:125:LYS:H	2.04	0.61
1:B:98:LYS:NZ	5:B:401:HOH:O	2.32	0.61
1:D:227:LYS:NZ	1:D:237:ARG:HH11	2.01	0.58
1:D:240:PHE:CE2	1:D:244:LEU:HD11	2.39	0.57
1:D:266:PHE:CZ	4:A:1:N:H3'	2.40	0.57
2:C:14:DG:N7	5:C:103:HOH:O	2.32	0.56
3:E:10:DC:H2''	4:A:1:N:H5'	1.87	0.56
1:B:190:GLU:HG2	1:B:193:ARG:NH2	2.21	0.55
2:C:6:DC:H2''	2:C:7:DG:C8	2.42	0.55
1:B:262:TYR:HA	1:B:264:TYR:CZ	2.42	0.54
1:D:133:LEU:HD11	1:D:167:LEU:HD23	1.90	0.52
1:D:289:HIS:HA	1:D:292:LEU:HD23	1.91	0.52
1:B:124:ASP:CG	1:B:125:LYS:N	2.64	0.51
1:D:227:LYS:HE2	5:D:514:HOH:O	2.12	0.49
1:D:238:GLN:HG3	1:D:242:GLU:OE2	2.13	0.49
1:B:271:MET:SD	1:B:271:MET:N	2.87	0.48
1:D:95:GLN:HA	1:D:131:VAL:HG12	1.95	0.48
1:B:227:LYS:O	1:B:227:LYS:HE3	2.13	0.48
1:B:190:GLU:HG2	1:B:193:ARG:HH22	1.79	0.47
1:D:227:LYS:HD2	1:D:232:PHE:CD2	2.49	0.47
1:D:254:ARG:HD3	1:D:254:ARG:HA	1.62	0.47
1:D:95:GLN:HB3	1:D:171:TYR:HB2	1.97	0.46
1:B:107:GLU:HA	1:B:110:GLU:HG3	1.97	0.46
1:D:282:LEU:CD1	4:A:1:N:H1'	2.45	0.46
1:D:92:LEU:HD21	1:D:94:LEU:HD21	1.98	0.46
1:B:81:LEU:HD22	1:B:111:LEU:HD11	1.99	0.45
1:D:227:LYS:HZ2	1:D:237:ARG:HD3	1.81	0.45
1:D:240:PHE:HE2	1:D:244:LEU:HD11	1.83	0.44
1:B:110:GLU:C	1:B:112:PRO:HD3	2.38	0.44
2:C:9:DC:H2''	2:C:10:DG:C8	2.53	0.43
1:D:227:LYS:NZ	1:D:237:ARG:HD3	2.34	0.43
1:B:106:ALA:O	1:B:109:GLN:HB2	2.18	0.42
1:D:159:VAL:HG21	1:D:195:PHE:HZ	1.84	0.42
1:D:292:LEU:N	1:D:293:PRO:HD2	2.35	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:173:PRO:O	1:B:185:ARG:HD3	2.19	0.42
1:B:254:ARG:HD3	1:B:254:ARG:HA	1.76	0.42
1:B:47:ASP:OD2	1:B:48:PRO:HD2	2.20	0.42
2:C:19:DA:H2''	2:C:20:DG:H5''	2.02	0.41
1:B:227:LYS:HE3	1:B:234:PRO:HD3	2.01	0.41
1:D:227:LYS:HD2	1:D:227:LYS:HA	1.73	0.41
2:C:10:DG:H2''	2:C:11:DA:C8	2.56	0.41
1:B:75:TRP:CE2	1:B:80:GLY:HA3	2.56	0.41
1:B:95:GLN:HB3	1:B:171:TYR:HB2	2.01	0.41
1:D:262:TYR:HA	1:D:264:TYR:CZ	2.55	0.41
3:E:3:DT:H2''	3:E:4:DG:C8	2.56	0.41
1:B:257:TYR:HB3	1:B:260:THR:OG1	2.20	0.41
1:D:177:ARG:NH2	4:A:2:DC:OP1	2.54	0.41
1:B:215:HIS:HD2	5:B:448:HOH:O	2.02	0.41
1:B:205:LEU:HD23	1:B:249:LEU:HD21	2.02	0.40
1:D:254:ARG:HG2	5:D:491:HOH:O	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	271/276 (98%)	255 (94%)	16 (6%)	0	100	100
1	D	269/276 (98%)	256 (95%)	13 (5%)	0	100	100
All	All	540/552 (98%)	511 (95%)	29 (5%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	229/235 (97%)	228 (100%)	1 (0%)	91	93
1	D	229/235 (97%)	228 (100%)	1 (0%)	91	93
All	All	458/470 (97%)	456 (100%)	2 (0%)	91	93

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	202	ARG
1	D	202	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	B	275/276 (99%)	0.49	23 (8%) 11 13	32, 47, 67, 83	0
1	D	272/276 (98%)	0.25	15 (5%) 25 30	26, 36, 58, 91	0
2	C	21/21 (100%)	0.22	1 (4%) 30 35	44, 60, 75, 88	0
3	E	10/10 (100%)	-0.07	0 100 100	53, 60, 62, 63	0
4	A	10/11 (90%)	0.57	2 (20%) 1 1	47, 65, 80, 86	0
All	All	588/594 (98%)	0.36	41 (6%) 16 20	26, 43, 67, 91	0

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	201	SER	5.5
1	B	127	GLY	4.1
1	D	124	ASP	4.0
1	D	148	ASP	3.7
1	B	207	LEU	3.5
1	D	126	GLU	3.5
1	D	149	GLU	3.5
1	B	43	ALA	3.4
1	B	152	ASP	3.3
1	B	208	CYS	3.3
4	A	11	DC	3.3
1	D	123	SER	3.1
1	B	168	VAL	3.1
1	B	124	ASP	3.1
1	B	150	GLU	3.0
2	C	11	DA	2.9
1	B	201	SER	2.9
1	B	221	ARG	2.8
1	B	271	MET	2.6
1	B	167	LEU	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	187	ARG	2.5
1	B	151	HIS	2.5
1	D	147	GLY	2.5
1	B	169	THR	2.4
4	A	10	DC	2.4
1	B	128	TYR	2.4
1	D	125	LYS	2.4
1	D	93	CYS	2.4
1	D	208	CYS	2.4
1	B	199	LEU	2.4
1	D	266	PHE	2.4
1	D	282	LEU	2.3
1	D	128	TYR	2.3
1	B	206	VAL	2.3
1	B	209	GLY	2.3
1	B	65	CYS	2.2
1	B	102	ASN	2.2
1	D	265	THR	2.2
1	B	183	GLU	2.1
1	B	158	ILE	2.0
1	D	211	LEU	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.